

Mathematics Teachers' Views and Use of Differentiated Instruction: The case of two teachers in the Winneba Municipality, Ghana

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Abstract

To ensure that the global sustainable development goal on education is achieved, the implementation of differentiated instruction (DI) is beginning to gain attention in the Ghanaian education system. But is Ghana embracing and implementing DI effectively in the mathematics classroom? This paper investigated two junior high school (JHS) mathematics teachers' views and use of DI in their mathematics classrooms. Qualitative data obtained through observations and semi-structured interviews in an embedded mixed methods study that employed the Solomon four group quasi-experiment design were analyzed and in this report. The results show that teachers used flexible grouping, tiered assignment, end of unit assignments, worksheets and ICT tools (though extremely challenging) as the convenient DI strategies. The interview data after the experiment disclosed that, DI impacted students' performance positively. However, the data showed that DI is time consuming, extremely challenging, expensive and required resources not readily available in public schools. Recommendations are made for the embracing of convenient strategies of DI in Ghanaian classrooms.

Keywords: differentiated instruction; mathematics teachers; mathematics classrooms

Introduction

In 2012, differentiation was introduced in the JHS mathematics curriculum of Ghana. The 2012 JHS mathematics curriculum captured differentiation in the preamble and spelt out how differentiation should be carried out in the mathematics classroom (Ministry of Education [MOE], 2012). However, Fletcher (2015) stated that there is still inequality in the Ghanaian mathematics classrooms and teachers in many ways perpetuate this inequality. At the 21st West Africa Examination Council (WAEC) Endowment Fund Lecture, Fletcher (2016) bemoaned the fluctuating performance of students in Mathematics and stated that, poor performance in the results of candidates meant the method for studying and teaching was inappropriate and wrongly used.

Research has shown that pedagogies such as problem solving, inquiry-based teaching, discovery, games, lecturing, and case studies affect the teaching and learning of mathematics (Dorier & Maass, 2020; Enu et al., 2015; Klang et al., 2021; Lambdin, n. d.; Mensah-Wonkyi & Adu, 2016; Panaoura, 2017; Teach & Kids Learn, 2017; Unal, 2017). Yet, mathematics teachers prefer the "Question and Answer" and "Demonstration" methods because these methods require less preparation and effort (Unal, 2017). Enu et al. (2015) attributed students' poor performance in mathematics to the use of lecture method of instruction in Ghanaian classrooms.

Muthomi and Mbugua (2014) stated that it is not appropriate for mathematics teachers to commit to one method since there are different ability groups of students in every classroom. Consequently, it is important for mathematics teachers to be creative and vary teaching,

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learning and assessing students to ensure maximum benefit for all students. Adebayo and Shumba (2014) stated that, students come to class in various permutations in terms of preferences, interests, background knowledge, language, communication, skills and readiness to learn. It is essential that mathematics teachers get to know their students individually and make effort to meet their individual needs.

DI is based on the belief that because there is variability among any group of learners, teachers should expect student diversity and adjust their instruction accordingly (Tomlinson, 1999). DI has been reviewed extensively and defined by researchers (Holli, 2008; Karadag & Yasar, 2010; Sousa & Tomlinson, 2011; Thakur, 2014; Tomlinson, 1999; Tomlinson & Moon, 2013) across the globe. For instance, Thakur (2014) believe that, DI is a wake-up call for all mathematics teachers around the globe because of the realization that all learners have a right to education, regardless of their individual characteristics or difficulties. For DI to be effective, mathematics teachers need to know, for each student, where that student begins and where that student is in the individual journey toward meeting the criteria of the lesson or unit (Hattie, 2012).

Several researchers (e.g., Bal, 2016; Cannon, 2017; Hapsari et al., 2018; Karadag & Yasar, 2010; Smith & Humpert, 2012) have used DI in their attempt to improve their students' achievement and employed several strategies and research methodologies to implement DI in the mathematics classroom. The strategies and methodologies used by for instance, Bal (2016), Cannon (2017), Karadag and Yasar (2010) Hapsari et al. (2018) and Smith and Humpert (2013) have yielded positive results. Some reported improvement in their students' mathematics achievement, while others experienced improvement in students'

attitudes positively. Joseph (2013) found that majority of teachers demonstrated good understanding of the concept of differentiated instruction. However, further findings suggested that both in-service and pre-service teachers do not consciously engage in differentiation through product, but majority of teachers differentiated process in their classrooms. Njagi (2014) in Kenya found that 80% of teachers were eager to attend lessons when using differentiated instruction, 76% of teachers get a great deal of satisfaction each time they are using differentiated instruction in the lesson, about 75% of teachers agreed that there was better students' achievement, 85% agreed that the instructional objectives are always achieved and 90% of teachers indicated that differentiated instruction makes the instructional process so interesting to the learners. Joseph et al. (2013) found that pre-service teachers responded favorably to the DI approach with 99% of them expressing willingness to experiment with DI in subsequent practicum sessions during their tenure at the university and 88% indicated a desire to use DI approach in their classrooms upon graduation. The pre-service teachers in Joseph et al. (2013) study also stated that DI increase students' motivation, improve study habits and problem solving, students recognizing the value of paying attention to different learning styles, the need to apply DI approach to their classroom teaching during practicum, making connections to real life classroom and world situations, group cooperation and collaboration, greater involvement, understanding and improved academic performance by all students and building improved relationships between students and instructors.

Research studies (e.g., Joseph et al., 2013; Njagi, 2014) have indicated that the concerns of some mathematics teachers regarding the implementation of DI include: the use of DI is

time consuming, long hours of planning, organizing and scheduling individuals and groups in a large class setting, difficult to cater for individual needs and preferences especially those individuals who prefer to work alone, and lastly, the examination culture which has pervaded teacher education institutions seemed to have great impact as some students questioned the fairness of the process when assessments were differentiated. Other factors identified was the time allocated to prepare for differentiated instruction because mathematics teachers have syllabus to cover, high expectations for results and huge workload. The studies by Joseph (2013), Njagi (2014), Smith and Humpert (2013) and Joseph et al. (2013) suggested that most mathematics teachers around the world agree that the positives of differentiated instruction outweigh the negatives. These studies (e.g., Joseph, 2013; Joseph et al., 2013; Njagi, 2014; Smith & Humpert, 2013) are an indication that other countries are taking huge steps to implement and evaluate the use of DI in order to assess the pros and cons to enable them find the best way to implement DI in their various classrooms. Can the same be said for Ghana? Though lots of studies have looked at the effect of differentiation, there is scarcity of data on how JHS mathematics teachers implement differentiated instruction in their classrooms on a day-to-day life in Ghana. Therefore, the purpose of this study was to investigate two Ghanaian JHS mathematics teachers' view and use of DI in their classrooms. The theoretical framework that guided the study was Gardner's Multiple Intelligence (MI) theory. Gardner (2006) noted that employing MI in instruction requires developing several educational strategies based on how an individual thinks to ensure that every particular learner is offered the utmost opportunity to learn, grow and succeed.

The research questions that guided the study were:

1. What are the views of the two junior high school mathematics teachers before, during and after their participation in the experiment involving a differentiated instructional design?
2. How did the two junior high school mathematics teachers, who participated in the study, implement the strategies of differentiated instruction?

Methodology

This paper reports on the qualitative aspect of a study which employed a mixed method design (Tashakkori & Creswell, 2007) with quasi experiment as a strategy for enquiry. The population for this study consisted of all mathematics teachers in the twenty-four (24) public JHS in the Winneba municipality. The sampling technique used was Solomon four group design. Consequently, two mathematics teachers (Teacher A and Teacher B) of the experimental groups were purposively selected as the sample. Semi-structured interview guide (before, during and after the experiment) and observations were used to collect data for analysis. The researchers were complete observers throughout the observation period while gathering notes for analysis. Duration for data collection was 12 weeks which is approximately one term in the Ghana Education System (GES). At the beginning of the term, the researchers checked the lesson notes, and assessments (exercises and examination) for the previous term and this process enabled the researchers to collect the first part of the interview data prior to the experiment. The interview data before the experiment formed the basis of a three-day, one-on-one (two hours) interaction with the two teachers. The interaction aimed to equip the teachers on the knowledge, application and strategies of DI as well as MI theory.

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Treatment

The first meeting was an interaction with teachers on the teaching and learning of mathematics and their students' achievement in the previous terms' examination. This led to the discussion of DI and differentiation by content (topics to teach), process (how teaching and learning the topics should be done), product (how to assess what has been taught) and environment (the atmosphere where teaching and learning is done).

The second day's interaction emphasized the MI theory. The nine MI that is; verbal-linguistic, logical-mathematics, musical, spatial, bodily-kinesthetic, naturalistic, interpersonal, intrapersonal, existential (Gardner, 2006) were discussed extensively. During the interaction, teachers admitted to seeing some students exhibiting some of these intelligences. The teachers were encouraged to use their knowledge in MI to identify the intelligences of each student and consciously consider the intelligences they identify when planning mathematics lessons for their students.

The third day focused on strategies of assessment in DI. The discussion focused on how teachers can use flexible grouping, jigsaw, scaffolding, anchoring activities, and interest centers in the process of teaching. Additionally, teachers learnt alternative ways to assess students using end-of-unit projects, tiered assignment, project work, portfolios, and formal assessment. Teachers were guided to design worksheets and end-of-unit project for assessments. Both teachers were encouraged to further read and watch videos of a model DI classroom. The two mathematics teachers were allowed to implement DI for about 8 weeks in their classrooms.

Fidelity of Implementation

To ensure that the two teachers practiced DI in their teaching throughout the experiment, they were given a fidelity of implementation (FOI) tool to monitor themselves and the researchers visited each teacher at least once a week throughout the term. During the visits, the researchers interacted with the teachers and discussed the FOI to find out how they were implementing DI in their classrooms, and also, their teaching lesson notes were checked. The visits revealed that, Teacher A designed a total of four (4) worksheets and 2 end-of-unit projects by the end of the term. On the other hand, Teacher B designed two (2) worksheets and 2 end-of-unit project for the students by the end of the term.

Organization of data

Thematic analysis was used to analyze the interview data. Braun and Clarke (2006) as cited in Maguire and Delahunt (2017), stated two levels of thematic analysis. These are semantic and latent. This study used semantic themes because the researchers used the surface meanings of the data and the analysis did not look for anything beyond what the teachers said. For the observation data, the researchers observed how teachers differentiated instruction by content, process, product and environment. During the observation, researchers were on the look-out for strategies of differentiation incorporated in the lessons. Consequently, the researchers only highlighted the part of the lessons where strategies of differentiation were incorporated.

Results

JHS mathematics teachers views on the use of DI before, during and after the experiment

Before the experiment the researchers interacted with the teachers to find out their teaching and learning practices and their knowledge in DI. The following questions

were asked before the treatment: (i) How did your students perform in the previous term's examination in mathematics? (ii) What guided you in setting questions for the examination? (iii) How do you go about your teaching and learning activity? (iv) Have you heard about Differentiation? (v) Are you aware that the 2012 syllabus recommends DI in the classrooms?

Themes that emanated from interviews were used to describe the teachers views on the use of DI before the implementation of the treatment.

Views on the presence of DI before the experiment

Knowledge of DI

When teachers were asked if they have ever heard of DI, Teacher A answered by asking

"Emm...like differentiating things" ...

then laughs afterwards.

Teacher B also answered in the form of a question by stating that

"Differentiation...is it using different methods to teach"? Teacher B continued by asking "Emm...is it related to maths"? "Mmmm well, I don't think I've heard it in mathematics".

To end the interview with the teachers before the experiment, the lead researcher asked the two teachers if they were aware that 2012 syllabus recommends DI in the classroom. Both teachers responded in the negative. Both teachers admitted that they were not aware that DI was recommended in the 2012 syllabus. The lead researcher probed further by asking the two teachers if they read the preamble of the JHS mathematics curriculum. The teachers admitted that they do not pay attention to the preamble of the curriculum since their concentration is mostly on the changes in the topics to be taught.

Implementation of DI

When teachers were interviewed about their general impression about the five weeks of engagement in DI strategies, both teachers observed it is involving and time consuming. Teacher A's response was that

"wow!!! I enjoyed myself. Today's lesson was very...very...nice. You know I spent a lot of time to research for this lesson. Since we talked about differentiation, I've been watching videos and reading a lot about it. Hm and I really really wanted to do it in my class. I had a lot to do so you see the lesson took more than my two periods. But I was very excited, the lesson was eh eh erm wow...was nice".

Teacher B responded that

"well today's lesson was good, just that you know too much time was spent on the teaching and learning activity hmmm, I didn't even finish the lesson so I couldn't give students any exercise to do. Do you know we are supposed to conduct exercises after each lesson so you see I have to come back later and give them the exercise?"

On their students' performance during their lessons, Teacher A stated that

"I prepared very well for my lesson, I downloaded videos and got shapes to explain what I had to teach. You know, I think the groupings worked very well. I was going round to see my students work so it was good. My students did very well today. Oh, they were excited when I asked them to bring cylindrical shapes to school. Everyone was contributing in today's lesson, watching the videos and were attentive to all the videos, oh my students did well today "paaa"".

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On the other hand, Teacher B stated that

“Well, I couldn't do all that I plan to do. You see when I put students in groups and gave them different assignments, it really made me tired. I think it's because I've not done it before checking different works at the same time hahaha I was going up and down all the time. As for my students they did very well today. The flexible grouping worked, some of my students who never talk were talking today, and leading their groups oh that was very nice”.

Views on experiences during the implementation of the DI experiment

On the interview during the treatment, the teachers were asked of any area they think needs improvement. Teacher A responded that

“Hmmm yes ooo my time, the lesson took almost more than two hours. You know if the next teacher was around, I wouldn't have finished my lesson. The lesson took a lot of time ooo but you see the students were not even tired”.

Teacher B was of the view that

“A lot of things that is, the time I spent teaching, my preparation, I think I could have done better. I want to do this again yeah so you come and see again”.

Views on experiences after the implementation of the DI experiment

After the two teachers have finished using DI in their classrooms after the 8 weeks period, they were asked the DI is helpful in what ways. Teacher A's response was that

“Very very helpful, my students have been working a lot this term. The assignments, worksheets, this term my students were always chasing me up and down with work”.

Teacher B responded that

“DI has been very very helpful. This term my students were always up and doing. You see them always grouped together trying to do their work. The playing around school reduced”.

The teachers were also asked to state the specific strategies that were helpful throughout the term. Teacher A stated that

“The use of worksheets and end of unit projects were very helpful. You realized that I even designed additional worksheets for my students. My students always had something to do. I actually added activities such as monthly test which were objectives at the end of every month”.

Teacher B also stated

“The worksheets and end of units [were] helpful when they are working alone. In the classroom, I was using the flexible grouping and tiered assignments to help them build their confidence and leadership in them”.

Willingness to recommend DI to other mathematics teachers

The teachers were asked if they will recommend DI to other mathematics teachers. Both teachers responded in the affirmative.

Teacher A stated *“oh yes! I will paa... I can! Will even help some of my colleagues to gain the knowledge I've got [ten] so they can also use it in their class”.* Teacher B also responded that *“Yes I will”.*

Finally, the two teachers were asked of their closing remarks after the whole experiment.

Teacher A stated that

“I think the time for the project was not enough and I will be glad if we can do it again. Hmmm I don't know if I

should say this eh but I think the differentiation eh, it can work in the primary school. You see the teachers in lower primary, they don't subject teaching so they have time to practice the strategies in differentiation. Also, identifying the type of multiple intelligence students exhibit takes time so if we had more time, it would have been better".

Teacher B stated that

"This exercise has been very helpful. You see although I've been teaching, I mean teaching well, you have introduced me to other things that will help me. I think that we should bring a lot of mathematics teachers together, you know and organize something like a workshop for them. Because it will help all of us. This is the first time I've been very close to my students so I'm sure I will be able to identify the type of intelligence they have with time".

Responses from the two teachers prior to the experiment is an indication that most JHS 2 students in the public schools were indifferent towards their performance in the previous term's examination. Teachers relied on past questions in the Basic Education Certificate Examination (BECE) to set questions for their students because they were preparing students for JHS3 where students write their final examination which is BECE. This shows that most teachers in Ghana are focused on helping students pass examinations since that is a measure of how good a teacher is to some extent. In addition, both teachers were guided by what the syllabus recommends for the teaching and learning activity regardless of the students. The interactions with the two teachers revealed that they had no knowledge of DI and did not understand the depth of the preamble that should cater for individual needs of every child in the mathematics classroom. The responses of both teachers

implied that teachers had no formal idea of DI. Consequently, they did not know about the strategies and how to implement DI in the classrooms. This may be due to the fact that both teachers had been teaching for more than ten years and differentiation was not popular in Ghana by then.

Data gathered during the experiment which was after the observation of the two teachers in the classrooms showed that, teachers had to spend more time than they usually do to prepare and execute a lesson to the different types of students in the class. Responses from both teachers was an indication that they enjoyed the lessons. Teacher A stated that the videos especially got the students excited and the students paid rapt attention to every video, which means Teacher A integrated the musical, spatial, interpersonal, intrapersonal, and logical mathematical intelligence (some types of Gardner's MI theory) in the same lesson to help students who demonstrate these intelligences to understand the concept of Volume of a cylinder. Teacher B was surprised to see students who prior to group work will never contribute to a lesson take up leadership roles (interpersonal intelligence) in their small groups. Both teachers assigned different tasks of varied difficulty levels (tiered assignment) to different groups, which Teacher B stated that it was an exhausting exercise. Teacher B specifically stated that, the lesson could be better if more time was spent on preparation before the lesson. Both teachers had to plan properly to be able to work within time frame allocated on the timetable.

After the treatment, the teachers were of the view that, DI was extremely helpful to the students. Furthermore, both teachers stated that the variety of tests and assignments kept students committed and serious with their studies throughout the term. The teachers noted an improvement on their relationship with students because they became closer to their students as compared to previous terms.

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Students were more comfortable to approach them with mathematics problems. From the responses, the researchers realized that both teachers were excited about the use of worksheets and end of unit projects designed by the researchers. One teacher was innovative by adding monthly tests to keep students engaged with work all the time. Teacher B was more excited by flexible grouping in the teaching and learning activity as it helped students to use their interpersonal intelligence in the classroom. Both teachers stated their willingness to recommend DI to other teachers and help other teachers with the knowledge and skills they have acquired throughout the period of the study.

Finally, Teacher A expressed interest in taking part in another project that involved DI. Teacher A however, recommended that the use of DI should be encouraged in the primary schools, because the lower primary have class teachers who are stationed in the classroom the whole day. Therefore, the primary school teachers can spend the whole day engaging students in the various strategies of DI and not be worried about time. Additionally, the primary school teachers have more contact hours with students and this could help teachers identify the type of multiple intelligence student exhibit at a very early stage. Teacher B also expressed excitement about the whole term and added that, the study brought to light the realization of new and innovative ways to make her students enjoy

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mathematics lessons. Both teachers were of the view that a bigger platform should be created for all mathematics teachers in the Winneba municipality to share ideas such as the use of DI in their classrooms to improve the teaching and learning of mathematics.

Implementation of the DI treatment by the two JHS mathematics teachers

Tables 1 and 2 present the summaries of what the two JHS mathematics teachers were observed doing during a lesson they taught in the third week of the implementation of the DI experiment. Teacher A taught a lesson on the topic 'Volume of a Cylinder' and Teacher B on 'Application of Ratio'.

Form Table 1 it will be observed that Teacher A not differentiate the topic to meet the abilities of different groups in the class. Selection of videos, pictures and slides were appropriate and connected to the lesson. The videos, pictures and slide shows appealed to most students and it made students attentive. Teacher A was very innovative to use students' sitting arrangement to group them since the available seats were dual desks which are not easy to move around. When it was necessary, some sitting partners were swapped. The teaching and learning activities were exciting and meaningful. The duration of the class was one hour forty minutes which was beyond the stipulated one hour (i.e. two periods) assigned for the lesson.

Table 1 Summary of the observation of Teacher A

Components of DI	Implementation	DI Strategy Used
Content	<ul style="list-style-type: none"> Volume of a Cylinder 	<ul style="list-style-type: none"> None
Process	<ul style="list-style-type: none"> Distribution of questions on previous knowledge was done in a whole class. Individual students were called to answer questions and teacher gave good feedbacks. The teacher used computer and a projector to show different cylindrical objects. Teacher played different videos on the definition of a cylinder and how to derive the formula for finding the volume of a cylinder. The videos were in the form of animations, slides with narratives and classroom scene. Students also brought variety of cylindrical shapes to the class. 	<ul style="list-style-type: none"> Friendly Environment Scaffolding
Product	<ul style="list-style-type: none"> “The radius of a cylinder is and the height is....., assuming the cylinder is a solid, find its total surface area and the volume”. Students had different answers in their various groups because of the different sizes of the cylinder used. 	<ul style="list-style-type: none"> Tiered Assignment
Environment	<ul style="list-style-type: none"> Classroom had dual desk for students so they sat in pairs and threes Students worked in small groups to answer questions 	<ul style="list-style-type: none"> Flexible grouping

Table 2 Summary of the observation of Teacher B

Components of DI	Implementation	DI strategy used
Content	<ul style="list-style-type: none"> Application of Ratio 	<ul style="list-style-type: none"> None
Process	<ul style="list-style-type: none"> Teacher wrote three separate questions on the board to explain the sub topic. Teacher led the whole class to solve the first example. Teacher asked students to sit in groups of their choice and allocated different questions to each group for discussion. 	<ul style="list-style-type: none"> Tiered Assignment Flexible grouping
Product	<ul style="list-style-type: none"> Three different questions of different levels of difficulty were assigned to different groups of students 	<ul style="list-style-type: none"> Tiered Assignment
Environment	<ul style="list-style-type: none"> Teacher created a friendly environment by engaging students as they entered the class before the start of the lesson The sitting arrangement stimulated discussion and teacher supervised each group’s work 	<ul style="list-style-type: none"> Flexible grouping

Therefore, Teacher A could not conduct class exercise which, according to the teacher is a requirement. Furthermore, Teacher A had to provide all the resources (Laptop, projector, extension board, and speakers) used in class because these resources are not available in the school. Although the lesson was successful, factors such as poor lightening in the classroom, excessive heat because the classroom had aluminum roofing with no ceiling and windows had to be closed to have a good view of the slides made the lesson fall short of a perfect DI classroom.

Observation of Teacher B showed that, the topic was not differentiated. Preparation for the lesson was inadequate because Teacher B read and selected most of the questions from a mathematics textbook the teacher brought to class. There were short breaks since the teacher had to take time to select questions to be discussed in the classroom. The teacher used flexible grouping by allowing students choose their group members. Questions of different difficulty levels were assigned to various groups and teacher gave students the opportunity to present their solutions to the whole class. Presentations by the students gave students the opportunity to exhibit their interpersonal and logical mathematical intelligences. Teacher B also spent more than an hour without covering what was intended for the lesson and did not conduct class exercise. Though the observation was not for assessment purposes, Teacher B suggested that the researchers schedule another observation.

Discussion

Prior to the treatment in this study, teachers had no knowledge of DI and therefore could not use variety of resource materials to enhance their teaching and learning activity. This finding is in contrast to the findings by Joseph (2013) who found out that teachers had

good knowledge of differentiation and made use of variety of resources.

During and after the implementation of the treatment, teachers revealed that implementation of DI is time consuming and tiring if they have to use it in every lesson. The teachers however stated that, DI made their lessons interesting because students who prior to the treatment have not been participating in class, had become active participants in lessons and showed enthusiasm towards lessons and engaging in the activities given to them. This finding agrees with the findings of Joseph et al. (2013) who found that students responded favorably to DI approach. After the treatment period, the teachers in this study stated that they were willing to recommend DI to other teachers in their school which is consistent with Joseph et al. (2013) who found that 99% of the teachers in their study were willing to experiment with DI. The teachers stated that, the convenient DI strategies that could be helpful in the Ghanaian classrooms were flexible grouping, worksheets, end-of-unit projects, tiered assignment and integrating ICT tools. Additionally, it was found that, teachers were eager and willing to recommend DI to other teachers. The teachers stated that identifying the type of intelligences a student exhibit is a daunting task. The two teachers made use and identified spatial, interpersonal, intrapersonal, and logical mathematical intelligence as some MI students demonstrated.

At the end of the DI implementation, it was observed that the topics to be taught are stated in the mathematics syllabus in Ghana. Therefore, Teacher A and B could not differentiate the content to be taught. This finding is in agreement with Tomlinson's (2010) finding that, the academic content that students are expected to master is today delineated in state-approved curricula. Thus, the content, in many ways, is specified in education today and cannot be varied greatly

by the teacher. However, process, product and environment can be differentiated in the classroom to suit the learner. Interactions and observations of teachers showed that even these “convenient” strategies cannot be used all the time.

Conclusions and Recommendations

Based on the findings it was concluded that, it is likely most mathematics teachers who have taught for several years in Ghana may not have in-depth knowledge of DI and consequently cannot implement DI strategies in the mathematics classroom. Additionally, there are several constraints to the implementation of DI in the mathematics classroom and only three sessions on the interaction of DI is not enough for effective implementation of DI in the classroom. Lastly, identifying the MI of students and designing mathematics lessons to suit students was difficult due to the expectations of Head teachers, GES guidelines and other stakeholders who are interested in the performance of students' BECE. It is recommended that teachers implement the strategies of DI that are convenient to use in the classrooms. Additionally, teachers should be supported to plan and learn how to use and practice some of the strategies of DI. Finally, training on DI should be well planned and rigorously done by Ghana Education Service.

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